HARD DISK DRIVE MOUNTING BRACKET FOR NOISE AND VIBRATION CONTROL

Cross-Reference to Related Applications

This application claims the benefit of the filing date of copending U.S. Provisional Application nos. 60/280,095, filed March 30, 2001 and 60/243,457, filed October 25, 2000.

Background

This application relates to hard disk drives of the type used for digitally recording information such as audio, video or other types of digital data. Such hard disk drives have been incorporated into electronic devices, known as "set top boxes," and are also used in computers and other types of electronic devices. Currently, such drives are commonly attached to a steel bracket which is, in turn, fastened to the chassis of the set top box or other device. A problem with such set top boxes has been noise emission. Such noise is typically a combination of airborne noise from the disk drive and noise caused by structurally borne vibrations transmitted from the disk drive to other set top box components, including the mounting bracket, chassis, top cover and circuit boards. Various approaches have been taken to reduce noise and vibration in such devices. Prior treatments have included isolating the disk drive from surrounding components with rubber grommets, damping the vibration with add-on treatments, using foam to absorb airborne noise and blocking noise by attaching a shield to the printed circuit board side of the disk drive. Such treatments contribute significantly to the overall cost of the device, and often are not effective, even in reducing noise to the level of a stand-alone hard disk drive.

Summary

This application is directed to a mounting arrangement for a hard disk drive which avoids disadvantages of prior arrangements while affording additional structural and operating advantages.

An important aspect is the provision of a mounting arrangement which effectively reduces propagation of noise and vibration from a hard disk drive.

Another aspect is the provision of an arrangement of the type set forth, which is of simple and economical construction and does not significantly add to the overall cost of the hard disk drive or the device in which it is used.

Another aspect is the provision of a mounting arrangement of the type set forth which minimizes the number of parts utilized.

The mounting arrangement consists of certain novel features and a combination of parts hereinafter fully described and illustrated in the accompanying drawings, it being understood that various changes in the details may be made without departing from the spirit, or sacrificing any of the advantages of the disclosed embodiment.

Brief Description of the Drawings

For the purpose of facilitating an understanding of the mounting arrangement, there is illustrated in the accompanying drawings a preferred embodiment thereof, from an inspection of which, when considered in connection with the following description, the mounting arrangement, its construction and operation, and many of its advantages should be readily understood and appreciated.

FIG. 1 is a front elevational view of a mounting bracket for a hard disk drive;

FIG. 2 is a front elevational view of a hard disk drive mounted on the bracket of FIG. 1;

FIG. 3 is a perspective view of the bracket of FIG. 2;

FIG. 4 is an enlarged, fragmentary, sectional view of a portion of the mounting bracket of FIG. 3;

FIG. 5 is a perspective view of another mounting bracket;

FIG. 6 is a front elevational view of a hard disk drive mounted on the bracket of FIG. 5;

FIG. 7 is a view similar to FIG. 6, illustrating an alternative mounting position of the hard disk drive;

FIG. 8 is a perspective view of still another mounting bracket; and

FIG. 9 is a front elevational view of the bracket of FIG. 9 with a hard disk drive mounted thereon.

Detailed Description

Referring to FIGS. 1 and 2, there is illustrated a hard disk drive, generally designated by the numeral 10, which has a housing 11 and includes a main drive mechanism 12 and a printed circuit board ("PCB"), the connector pins for which are shown at 13, mounted on what is normally the underside of the main drive mechanism 12. It has been found that in typical hard disk drives, noise emitted from the PCB side of the disk drive 10 is greater than that emitted from the top side of the housing 11. Heretofore, this printed circuit board noise has typically been reduced by attaching a metal and foam shield 15 to the bottom of the housing 11 to block emission of the PCB noise. This, of course, adds an additional part to the assembly and adds to the overall expense of the device.

Referring to FIGS. 2 and 3, there is illustrated a mounting bracket 20 for supporting the hard disk drive 10 and for damping noise and vibration emitted therefrom. The bracket 20 is generally channel-shaped, having a rectangular main panel 21 integral along the opposite side edges thereof with rectangular, depending side walls 22 and 23 which are, in turn, respectively integral at their lower edges with outturned rectangular attachment flanges 24 and 25. Formed through each of the side walls 22 and 23 is a pair of longitudinally spaced-apart, circular apertures 26 and formed through each of the attachment flanges 24 and 25 is a pair of longitudinally spaced-apart, small circular holes 27.

A significant feature is the material of construction of the bracket 20. In order to function effectively, the bracket must not contribute to noise or vibration. Contribution will occur if the bracket 20 is forced into resonance by amplified vibrations transmitted from the hard disk drive 10 to the bracket 20. In order to avoid amplifying vibrations, the bracket 20 is formed of a material which has adequate strength and rigidity, while damping noise and vibrations. Referring to FIG. 4, preferably, the bracket 20 is formed of a damped metal laminate material 30, which includes outer metal skins or layers 31 and 32, constraining therebetween a thin core 33 of viscoelastic material. Such damped metal laminate material is sold by Material Sciences Corporation, and may have outer metal layers 31 and 32 of substantially the same thickness, which may vary, depending upon the application, the viscoelastic core 33 typically being substantially thinner.

Referring to FIG. 2, in use, the hard disk drive 10 is disposed beneath the main panel 21 of the bracket 20 and is supported on the side walls 22 and 23 thereof by suitable mounting screws 35 extending through the apertures 26, the bracket 20 being isolated from the hard disk drive 10 by the

use of isolating grommets 36, respectively disposed on the inner and outer sides of the side walls 22 and 23 and receiving the screws 35 therethrough. The grommets 36 may be constructed of a soft rubber material, preferably having a high damping characteristic. The bracket 20 is mounted in place in the associated set top box or other device by suitable fasteners (not shown) received through the holes 27 in the attachment flanges 24 and 25.

It is a significant aspect that the hard disk drive 10 is mounted in an inverted position on the bracket 20, with the PCB13 facing upwardly and disposed closely adjacent to the inner surface of the main panel 21. Thus, the main panel 21 serves as a shield for noise and vibrations emitted from the PCB side of the disk drive and obviates the use of a separate shield.

Referring now to FIGS. 5-7, there is illustrated a mounting bracket 40 for supporting the hard disk drive 10 and damping noise and vibration emitted therefrom. The bracket 40 may be formed of the same material 30 described above in connection with FIGS. 1-4 and is generally channel-shaped, having a rectangular main panel 41 integral along the opposite side edges thereof with rectangular, depending side walls 42 and 43 which are, in turn, respectively integral at their lower edges with outturned rectangular attachment flanges 44 and 45. Formed through the main panel 41 are two pairs of longitudinally spaced-apart, circular apertures 46 and formed through each of the attachment flanges 44 and 45 is a pair of longitudinally spaced-apart, circular holes 47.

Referring to FIG. 6, in use, the hard disk drive 10 is disposed beneath the main panel 41 of the bracket 40 and is supported on the main panel 41 by suitable mounting screws 49 extending through the apertures 46. The bracket 40 is mounted in place in the associated set top box or other device by suitable fasteners (not shown) received through the holes 47 in the attachment flanges 44

and 45. The fasteners may be isolated from the bracket 40 by the use of isolating grommets 48, respectively disposed in the holes 47 and receiving the fasteners therethrough. The grommets 48 may be constructed of a soft rubber material, preferably having a high damping characteristic.

It is a significant aspect that the hard disk drive 10 is mounted in an inverted position on the bracket 40, with the PCB facing upwardly and disposed against the inner surface of the main panel 41. Thus, the main panel 41 serves as a shield for noise and vibrations emitted from the PCB side of the disk drive 10 and obviates the use of a separate shield.

Referring to FIG. 7, there is illustrated an alternative mounting arrangement, wherein the hard disk drive 10 is mounted in an upright position on the upper surface of the main panel 41 of the bracket 40. The hard disk drive 10 may, again, be secured in place by suitable fasteners screwed through the apertures 46 into the PCB of the hard disk drive.

Referring to FIGS. 8 and 9, there is illustrated an alternative mounting bracket 50 for supporting the hard disk drive 10. The bracket 50 is generally channel-shaped, having a rectangular main panel 51 integral along the opposite end edges thereof with rectangular, depending end walls 52 and 53 which are, in turn, respectively integral at their lower edges with outgunned rectangular attachment flanges 54 and 55. Formed through the main panel 51 are two pairs of longitudinally spaced-apart, circular apertures 56 and formed through each of the attachment flanges 54 and 55 is a pair of longitudinally spaced-apart circular holes 57. Integral with the opposite side edges of the main panel 51 and extending upwardly therefrom are rectangular side walls 58 and 59. The bracket 50 may be made of the same material as the bracket 40 described above.

In use, the hard disk drive 10 is mounted on the upper surface of the main panel 51 between the side walls 58 and 59, being secured in place by suitable fasteners extending through the apertures 56, as described above in connection with the bracket 40. The bracket 50 is mounted on the associated set top box or other device by the use of suitable fasteners (not shown) extending through the holes 57 and being isolated by isolating grommets 48, in the same manner described above for the bracket 40.

By use of any of the mounting brackets 20, 40 or 50, the PCB shield 15, typically used in the prior art, can be eliminated with minimal increase in system noise. An additional benefit of the use of either of the mounting bracket 40 or 50 is that it serves as a heat sink for improved heat dissipation from the PCB of the drive 10. Because of its close proximity to the bracket, heat from the hard disk drive 10 can be transferred more efficiently into the bracket. As a result, the steady-state temperature of the hard disk drive 10 decreases. Lower drive temperatures can eliminate the need for a cooling fan and contribute to longer drive life.

If desired, high emissivity coatings or films could be used on the inside and/or outside surfaces of the bracket 40 or 50 to improve radiant heat transfer, and assist the heat sinking effect of the bracket 40. Also, application of an electrically insulating coating or film to the inside of the bracket 40 or 50 could be utilized. Such a layer would protect against short-circuiting caused by accidental contact between the circuit board and the conductive bracket 40 or 50. Placement of a thin foam layer between the bracket and the PCB could also be used, if desired. Such a foam layer would serve the dual purpose of acoustical absorption and electrical insulation.

It will be appreciated that, in lieu of the damped laminate material 30, damping could be achieved by using a standard metal bracket with an add-on treatment, consisting of a low-modulus material adhered to either the inner surface or the outer surface of the bracket 20, 40 or 50, and constrained by a higher-modulus outer layer. The add-on treatment could also be a mastic (a polymer material filled with a high-density powder) or an all-polymeric treatment.

Also, in order to achieve even greater noise reduction with any of the brackets 20, 40 and 50, a shield 15 could be added over the PCB side of the housing 11, as in FIG. 1.

The matter set forth in the foregoing description and accompanying drawings is offered by way of illustration only and not as a limitation. While particular embodiments have been shown and described, it will be obvious to those skilled in the art that changes and modifications may be made without departing from the broader aspects of applicants' contribution. The actual scope of the protection sought is intended to be defined in the following claims when viewed in their proper perspective based on the prior art.